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324. Proposed by R. D. CARMICHAEL, Princeton University.

Sum the *finite* series
 $\frac{16n^2 - 2^2}{4!} - \frac{(16n^2 - 2^2)(16n^2 - 4^2)}{6!} + \frac{(16n^2 - 2^2)(16n^2 - 4^2)(16n^2 - 6^2)}{8!} - \dots$
where n is a positive integer.

Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

$$\cos m\theta = 1 - \frac{m^2}{2!} \sin^2 \theta + \frac{m^2(m^2 - 2^2)}{4!} \sin^4 \theta - \frac{m^2(m^2 - 2^2)(m^2 - 4^2)}{6!} \sin^6 \theta + \dots$$

Let $m=4n$, then

$$\begin{aligned} \cos 4n\theta &= 1 - \frac{16n^2}{2!} \sin^2 \theta + \frac{16n^2(16n^2 - 2^2)}{4!} \sin^4 \theta \\ &\quad - \frac{16n^2(16n^2 - 2^2)(16n^2 - 4^2)}{6!} \sin^6 \theta + \dots \end{aligned}$$

Let $\theta = \frac{1}{2}\pi$, then $\cos 4n\theta = \cos 2n\pi = 1$.

$$\begin{aligned} \therefore 1 &= 1 - \frac{16n^2}{2!} + \frac{16n^2(16n^2 - 2^2)}{4!} - \frac{16n^2(16n^2 - 2^2)(16n^2 - 4^2)}{6!} \\ &\quad + \frac{16n^2(16n^2 - 2^2)(16n^2 - 4^2)(16n^2 - 6^2)}{8!} - \dots \\ \therefore \frac{1}{2} &= \frac{(16n^2 - 2^2)}{4!} - \frac{(16n^2 - 2^2)(16n^2 - 4^2)}{6!} \\ &\quad + \frac{(16n^2 - 2^2)(16n^2 - 4^2)(16n^2 - 6^2)}{8!} + \dots \end{aligned}$$

GEOMETRY.

345. Proposed by LLOYD HOLSINGER, Bradley Polytechnic Institute, Peoria, Ill.

If a variable polygon move in such a way that its n sides turn severally round n fixed points O_1, O_2, \dots, O_n while $n-1$ of its vertices slide, respectively, along $n-1$ fixed straight lines v_1, v_2, \dots, v_{n-1} , then the last vertex will describe a conic; and the locus of the point of intersection of any pair of non-adjacent sides will also be a conic. Cremona's *Projective Geometry*.

Solution by HOWARD C. FEEMSTER, A. B., York College, York, Neb.

Let the sides of the polygon a_1, a_2, \dots, a_n turn severally around the n fixed points O_1, O_2, \dots, O_n , describing n flat pencils, O_1, O_2, \dots, O_n , while the $n-1$ vertices A_1, A_2, \dots, A_{n-1} slide, respectively, along the $n-1$ fixed straight lines, v_1, v_2, \dots, v_{n-1} , forming $n-1$ ranges, A_1, A_2, \dots, A_{n-1} . Pencils O_1 and O_2 are perspective with range A_1 ; ranges A_1 and A_2 are perspective with pencil O_2 ; pencils O_2 and O_3 are perspective with range A_2 , thus making the n pencils and $n-1$ ranges projective.

Now the projective pencils O_1 and O_n or any two of the non-consecutive pencils (using above order) will not, in general, be perspective, and every such intersection will thus describe a conic range as its locus. *Encyclopedia Britannica*, "Projective Geometry," Sec. 45.

347. Proposed by W. J. GREENSTREET, M. A., Marling School, Stroud, England.

ABC is a triangle, and D, E, F , are the mid points of the arcs of its nine-point circle cut off by BC, CA, AB , respectively. The inscribed circle touches these sides at X, Y, Z . Are the lines DX, EY, FZ concurrent? A purely geometrical discussion required.

Solution by BENJ. F. FINKEL, Ph. D., Drury College, Springfield, Mo.

In my *Mathematical Solution Book*, page 461, it is shown that the perpendiculars to the chords cut off by the nine-point circle, at the mid-points intersect in a point S , which is the center of the nine-point circle. These perpendiculars produced from the chords to the subtended arcs, bisect the smaller arcs in D, E , and F . Since the in-circle is tangent to the chords or chords produced in X, Y, Z , perpendiculars erected at these points meet in a point, I , the center of the in-circle. Drawing the lines DX and EY , and producing them until they meet IS , or IS produced, in C and C' , respectively, we have the triangles SDC and SDC' .

The triangles SDC and IXC are similar, as are also SDC' and IYC' . Hence, SD , (the radius of the nine-point circle) : IX , (the radius of the in-circle) = $SC : IC$; and similarly, SE , the radius of the nine-point circle : IY , the radius of the in-circle, = $SC' : IC'$. Hence, $SD - IX : IX = SC - IC (= SI) : IC$, and $SE - IY : IY = SC' - IC' (= SI) : IC'$. Hence, $IC = IC'$ and, therefore, DX and EY intersect the line joining the nine-point circle and the in-circle in the common point C . In the same way, it may be shown that the line FZ intersects the same line in the point C . Hence, the three lines are concurrent.

CALCULUS.

275. Proposed by C. N. SCHMALL, 604 East 5th Street, New York City.

Explain fully why the circular measure of an angle is used in the calculus.